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The Effects of Handedness on Personal Preferences

Ryan McAllen

Abstract

Lateralization of cerebral function divides the cognitions of the brain between two hemispheres, resulting in differences in thought processing between people based potentially on lateralization. Recent research suggests that these differences in lateralization may render some people more likely to hold certain preferences, attitudes, and beliefs about the world. Individual differences in lateralization can be evaluated with simple inventories measuring handedness. With this in mind, the following study attempted to determine if differences in handedness could be associated with differences in personal preferences, particularly in regards to types of food and forms of entertainment. It evaluated participants by using the Edinburgh Handedness Inventory (Oldfield, 1971) to create groups of inconsistent-handers and consistent-handers, then surveyed them on questionnaires of food preferences and entertainment preferences, comparing the responses between the two groups. The results for this study showed no significant differences between the responses provided by inconsistent-handers and consistent-handers. Thus, no definitive conclusions could be drawn from this research. While self-report surveys may be effective measures on this topic, the surveys used here may not be reflective of the participants' actual behaviors, and therefore the results of this study may not reflect the research question accurately.

Keywords: *Handedness, personal preference*

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by

Ryan McAllen

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Thesis Committee:

[redacted]

Peter Vietze
Thesis Sponsor

[redacted]

Ruth Propper
Committee Member

[redacted]

Kenneth Sumner
Committee Member

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RYAN McALLEN

Montclair State University

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Background

Psychology is the study of human behavior, and neuroscience is, in part, the study of the neuronal connections in the brain. An important concept to understand in the biology of the brain is that of lateralization, the extent to which cognitive processes are lateralized primarily to one hemisphere of the brain over the other. Lateralization has been demonstrated in most vertebrates, including humans (Brown & Magat, 2011). Brain function is largely organized contralaterally, which means that the right hemisphere controls the left half of the body and vice versa, thus creating a relationship between physical activities performed on one half of the body (e.g. writing, throwing a ball) and the activity of the cerebral hemisphere on the opposite side of the brain. Fundamentally, lateralization demonstrates that the brain is asymmetrical; just as the physical shape and construction of one hemisphere is not a perfect biological mirror of the other, the two hemispheres do not process information as a mirror of one another. Evaluation of an individual's handedness, the degree to which they favor the use of either their left hand or right hand to perform tasks, is a useful method of approximating lateralization of function (Prichard et al., 2013). Ultimately, the distributed brain functions are combined together to encompass the whole of the brain's informational set and cognitive function, but there is evidence that inconsistently-handed individuals, more commonly referred to as ambidextrous persons, can better combine this information, thus giving them distinct differences and sometimes advantages and disadvantages over consistently-handed individuals in some tasks (Prichard, Propper, & Christman, 2013).

While different for each person, certain cognitive tasks are primarily managed by one hemisphere or the other, before the information from the two hemispheres is combined together. An example of how information is initially partitioned can be explained in the dichotomy of "local" processing and "global" processing, which are attributed to the left and right hemispheres respectively (Evans, Shedden, Hevenor, & Hahn, 2000). Local processing involves the finer details of a narrower scope of information, and global processing involves the broader picture with fewer details. For a visuospatial example, when a person observes a house, global processing would involve recognizing the shape and size, and local processing would involve the analysis of the direction of the grain lines in the woodwork and the number of shingles on the roof, as well as any discoloration in the doorknob. In the case of the eyes, each eye is not wholly managed by the contralateral hemisphere, rather each eye is split into two visual fields. The information from the left sides of the visual fields of both eyes is sent to the right hemisphere of the brain, and the information from the right sides is sent to the left hemisphere. Ramachandran (1998) suggests that the right hemisphere is able to act as a "broad searchlight" that attends to both halves of the visual space, whereas the left hemisphere uses a "spotlight" attuned to the details of the two halves of the total visual field with emphasis on the right visual fields (Ramachandran, 1998).

Neuroimaging methods (e.g. Functional magnetic resonance imaging--fMRI) are popular measures by which brain activity is observed, especially in regards to the changes in cognition in real time response to stimuli. Like all measures of brain activity, however, fMRI is only an approximation thereof and very cost-prohibitive to be utilized across

large groups of people. At least in the case of cerebral lateralization, handedness, the degree to which one prefers using a particular hand for a given task, can be used as an effective index for the measurement of lateralization (Prichard et al., 2013). Simple handedness surveys can provide converging evidence of brain activity for more exhaustive imaging studies. Oldfield (1971) developed the Edinburgh Handedness Inventory (EHI) to measure handedness. The EHI surveys a number of common physical tasks, from writing to throwing a ball to holding a knife. Scores range from -100 to +100, with -100 indicating strong left-handedness and +100 indicating strong right-handedness (Oldfield, 1971). The majority of the population, around 90 percent, score +80 or higher, indicating that 90 percent of the population is consistently-right-handed (CRH) (Prichard et al., 2013). Thus, anyone with a score of +80 or higher is denoted consistently-right-handed, anyone with a score of -80 or lower is denoted consistently-left-handed (CLH), and anyone with a score between -80 and +80 is denoted inconsistently-handed (ICH), known more commonly as the “ambidextrous."

With 90 percent of the general population scoring +80 this leaves the remaining ten percent to be divided between CLH and ICH. Lansky et al., as cited in Niebauer, Christman, Reid, & Garvey (2004), states the CLH population to be only 2-3 percent of the general population (Niebauer, Christman, Reid, & Garvey, 2004). Despite its relative rarity compared to consistent-right-handedness, ambidexterity is tied to several cognitive advantages (Prichard et al., 2013), most importantly the synthesis of the information processed separately by two cerebral hemispheres. The corpus callosum is the largest white matter tract in the brain, and its primary role is the relaying of information between

the two hemispheres. Inconsistently-handed people, on average, have a larger corpus callosum than those who are more consistent in the use of their hands (Prichard et al, 2013), which means more neurons to facilitate greater interconnectivity between the hemispheres.

Much of the research in lateralization is based on cognitive information processing and physical skills, but lateralization can also be used to evaluate cognitive convictions better known as beliefs. Ramachandran (1998) hypothesizes that the left hemisphere serves as the maintainer of the "status quo", important for maintaining our current state of knowledge and our beliefs at the present time. This maintenance of cognitive stability, the status quo, can come with the cost of imposing it within one's mind, at the expense of newer information that would otherwise amend the existing knowledge base. The right hemisphere in turn acts as an "anomaly detector," to signal information that conflicts with the status quo to the left hemisphere and thus update the body of knowledge (Ramachandran, 1998). Evans (2000) and Niebauer et al. (2004) showed that consistently-handed children were more likely to hold "young-earth creationist " beliefs compared to inconsistently handed children, indicated by first forming beliefs about evolution derived from religious teachings early in life followed by a failure to update the beliefs with scientific information presented later in life (Evans, 2000). Niebauer et al. attributes this to an attenuated exchange between the left and right hemispheres resulting in a general reduction in belief updating capability (Niebauer et al., 2004). In the realm of personal preferences, Christman (2013) reported that consistently-right-handed research participants are more likely to demonstrate dislike for unfamiliar

genres of music than inconsistently-handed participants, with a marginally higher preference for popular genres (Christman, 2013). This raised the following question for research: If consistent-right-handers are less likely to like unfamiliar genres of music than inconsistent-handers due to attenuated belief updating and reduced interhemispheric activity, could the same be said in regards to types of food, as well as forms of entertainment besides music?

Hypothesis. Inconsistent-handers will demonstrate more positive preferences on surveys that measure food preferences and entertainment preferences, based on the assertion that increased communication between hemispheres is associated with increased belief updating, and therefore heightened tolerance for less popular and less familiar genres of music.

Methods

Participants

Participants consisted of 37 adults between the ages of 18 and 40, who were residents of New Jersey at the time of the experiment, recruited through in-person pleas. Many were college-educated in New Jersey, if not attending Montclair State University as an undergraduate or graduate student at the time of the experiment. One was dismissed due to visible signs of agitation and annoyance during the procedure, for a total of 36 participants (*M*age = 26.33, *SD* = 4.62, 16 male, 20 female). Groups were formed using the Edinburgh Handedness Inventory (Oldfield, 1971) to establish sample groups of Inconsistent-Handers (ICH) for scores between -80 and +80, and Consistent-Handers

(CH) for scores below -80 and above +80. Gender distribution was 5 males and 7 females in the ICH group and 11 males and 13 females in the CH group (definitions for handedness provided in greater detail below in Analysis). They participated in the study as volunteers and as such did not receive compensation. They were briefed on the purpose of the study prior to the study and handed a printed packet of the surveys to begin the study. Upon completion, they were told the study's hypothesis in order to provide full disclosure of the study in which they had participated.

Design

The study uses a between subjects design comparing consistent-handed individuals (CH) to inconsistent-handed individuals (ICH). The independent variable is Handedness, and the dependent variables are the composite scores of the answers in each category given on the questionnaires.

Materials

The study utilizes three questionnaires comprised of the Edinburgh Handedness Inventory (Oldfield, 1971) and two preference surveys, one titled "Food and Beverage Preferences," and the other titled "Media and Entertainment Preferences," created by the researcher. These questionnaires were determined to have face validity, and were constructed using sales data from the Entertainment Software Association (Entertainment Software Association, 2015) and Nielsen (Nielsen, 2014; Nielsen, 2015).

*Edinburgh Handedness Inventor*y consists of 10 items, asking participants to indicate the preference for the use of their hands in specified tasks: Writing, drawing, holding a spoon, opening jars, using a toothbrush, throwing an object, the upper hand

when sweeping with a broom, using scissors, holding a knife, and striking a match. The inventory has been employed throughout the field of neuroscience since its development, and even when translated into Chinese maintained a Cronbach's alpha of at least .87 (Yang et al., 2018). At the bottom, it asks participants if their mother and/or father are left-handed, how many siblings they have, and if so, if those siblings are left-handed. These items were retained only to maintain the internal validity of the EHI used and were not used in the analysis. After this, a line was added for participants to write their age and circle their gender, used to collect demographic information. The results of the EHI were used to divide the participants into groups of inconsistent-handers (ICH) and consistent-handers (CH) for analysis of responses to the other two inventories (see below for categorization criteria). The EHI used in this experiment, modified with the line for demographic information, is included in Appendix A.

Food and Beverage Preferences consists of a 25-item, Likert-rated inventory ranging from 1 ("Strongly Dislike") to 5 ("Strongly Like"), with an option for "No opinion" in the middle, with a value of 3. The items are common food items, some of which are members of the same group e.g. vegetables, meats, fruits. The scores for these groups of three to four items were combined to create composite scores: beverages, condiments, dairy, fruits, meat, vegetables, other. The categories were listed alphabetically in the inventories to prevent the category from influencing individual scores. The composite scores for each individual were then averaged together to produce the ratings for each group. These ratings were used in the analysis. Participants were instructed to select "No opinion" if they have never eaten the food in their lives, or if they

were unable to consume the food for cultural reasons, such as religion, or due to dietary restrictions such as allergies. This was to prevent them from having to disclose the information directly if they did not desire to do so without adversely affecting their reporting of the items. The questionnaire is included in Appendix B.

Media and Entertainment Preferences consists of 20 items, rated from 1 ("Strongly Dislike") to 5 ("Strongly Like"), with an option for "No opinion" in the middle, with a value of 3. Of the 20 items, 9 refer to genres of television and movies (*comedies*, *dramas*, *educational*, *fantasy*, *horror*, *mystery*, *political*, *talk shows*, and *thrillers*), 6 refer to genres of music (*alternative rock*, *classical music*, *metal*, *rap*, *rhythm and blues*, and *techno*), and 5 refer to genres of video games (*adventure games*, *fighting games*, *racing games*, *role playing games*, and *shooting games*). The scores for these genres were averaged into composites used for the analysis. Participants were instructed to answer "No opinion" if they did not have enough knowledge of the genre to render an opinion, though they were permitted to ask for clarification. The questionnaire is included in Appendix C.

In each category of the questionnaires, the items were characterized as "popular" and "less popular" according to popularity and sales data provided by the Entertainment Software Association (ESA, 2015) and Nielsen (Nielsen, 2014; Nielsen, 2015). In the TV and movies category, the "less popular" items were *educational shows, mystery shows,* and *talk shows.* In the Music category, the "less popular" items were *classical music* and *techno music.* In the Video games category, the "less popular" items were *adventure games, fighting games, and racing games.* It was expected that the combinations of these

items within the same categories would influence the average scores in a substantive way based on ICH's heightened tolerance for less popular genres compared to CH.

Procedure

Participants were issued all three inventories in a stapled, 3-page packet. Each inventory fit on one page, and so they were organized in different combinations. For example, the EHI was the first page in one set of packets, but it was the third in a different set. There were a total of six different combinations of page ordering, with participants randomly assigned one of these orders to mitigate any potential order effect. They completed the surveys in the sequence they were assigned, most in less than five minutes, well below an originally-estimated time of five to ten minutes. During the test period, they were allowed to ask for clarification on the definitions of items, if necessary, but beyond this, the experimenter did not interact with the participants.

Analysis

The Edinburgh Handedness Inventory is scored on a range from -100 to 100. The typical dividing point is 80, which indicates someone who is strongly right-handed or RH. Anything less than 80 is either inconsistently-handed ($-80 < ICH < 80$) or strongly-left-handed (≤ -80). These descriptors formed the two groups for analysis. Due to the importance of degree of handedness rather than direction (Pritchard et al., 2013), consistent-left-handers were grouped with consistent-right-handers. Thus there were two groups, inconsistently-handed (ICH, n=12) and consistently-handed (CH, n=24).

The items from the two inventories were evaluated using composite scores ranging from 1.00 to 5.00, corresponding to the survey descriptors ranging from

"Strongly Dislike" to "Strongly Like," comparing the mean averages of participants in the ICH group for a particular composite against the mean averages in the CH group for that particular composite. Independent samples one-tailed T-tests were used to analyze the results.

Results

Thirty-six participants completed the three surveys, with 12 forming the Inconsistent-Handers group (ICH) and 24 forming the Consistent-Handers group (CH), based on the results of the Edinburgh Handedness Inventory (Oldfield, 1971). Results were analyzed using one-tailed independent t-tests.

Table 1 shows the results for the Food and Beverage Preferences survey, organized into seven composite scores for Beverages, Condiments, Dairy, Fruits, Meats, Vegetables, and Other, consisting of *beans*, *mushrooms*, and *tofu*. Standard deviations are included beside each group. The results for Beverages were 3.54 and 3.92 for ICH and CH respectively (SD = 0.81 and 0.75 respectively). The results for Condiments were 3.61 for both groups (SD = 0.68 for ICH and 0.75 for CH). The results for Dairy were 4.25 and 4.32 for ICH and CH respectively (SD = 0.68 and 0.61). The results for Fruits were 3.96 and 4.12 (SD = 0.99 and 0.64). The results for Meat were 3.92 and 4.17 (SD = 0.62 and 0.67). The results for Vegetables were 3.75 and 3.94 (SD = 0.59 and 0.72). The results for Other were 3.08 and 3.40 (SD = 1.39 and 0.84). The data indicated no significant differences between ICH and CH for the food preference survey. (Table 1).

Table 2 shows the results for the Media and Entertainment Preferences survey, organized into three composite scores for TV and movies, Songs, and Video games. Standard deviations are included beside each group. The results for TV and movies were 3.68 and 3.89 for ICH and CH respectively (SD = 0.66 and 0.42 respectively). The results for Songs were 3.36 and 3.61 (SD = 0.65 and 0.54). The results for Video games were 3.88 and 3.70 (SD = 0.66 and 0.73). The data indicated no significant differences between ICH and CH (Table 2).

Table 1 - Food Preferences

	ICH	*SD*	CH	*SD*	Sig.
Beverages	3.54	0.81	3.92	0.75	0.10
Condiments	3.61	0.68	3.61	0.75	0.50
Dairy	4.25	0.68	4.32	0.61	0.38
Fruits	3.96	0.99	4.12	0.64	0.30
Meat	3.92	0.62	4.17	0.67	0.14
Vegetables	3.75	0.59	3.94	0.72	0.19
Other	3.08	1.39	3.40	0.84	0.24

Table 2 - Media and Entertainment Preferences

	ICH	*SD*	CH	*SD*	Sig.
TV and movies	3.68	0.66	3.89	0.42	0.17
Songs	3.36	0.65	3.61	0.54	0.15
Video games	3.88	0.66	3.70	0.73	0.29

Discussion

The purpose of the study was to determine if differences in handedness, and therefore cerebral lateralization, are related to differences in food and entertainment preferences.

In the Food and Beverage Preferences survey, it was predicted that the ICH group would have higher composite scores. Numerically, it was found that the CH group scored higher on all composite scores, with the exception of Condiments, which had no difference ($p = 1.00$). The p-values for all measures were ≥ 0.10.

In the Media and Entertainment Preferences survey, it was predicted that the ICH group would have higher composite scores. It was found that the CH group scored higher on all composite scores, with the exception of Video games. The p-values for all measures were ≥ 0.15.

In summary, the data does not conform to the hypothesis that ICH would have higher liking preferences than CH. In fact, in all categories except for video games, CH scored higher than ICH, indicating greater liking in CH compared with ICH. Most importantly, none of the data reached statistical significance, and on that basis we fail to reject the null hypothesis.

Limitations

The first consideration is that the sample size was very low and only consisted of New Jersey residents. A study such as this could have been easily distributed and executed over the Internet, allowing for much larger sample groups and therefore a result that is much more generalizable to the overall population.

One consideration is that the items in each composite may not have been adequate in and of themselves to qualitatively establish a "popular" versus "less popular" relationship in the items. Based on popularity and sales data from Nielsen (Nielsen, 2014; Nielsen, 2015) and the Entertainment Software Association (Entertainment Software Association, 2015), certain items in each Media and Entertainment category were characterized as "less popular" compared to the other items in the categories. It was predicted that these combinations of items would result in CH reporting unfavorable opinions on these items (represented by scores of 1 through 3) rather than more favorable opinions (scores of 4 and 5) compared to ICH, resulting in higher-on-average composite scores for ICH. The actual outcome was, even when taking into consideration the lack of statistical significance, that CH scored higher in all categories save for the Video games category. This could mean there weren't enough unpopular items in the categories to influence the scores, or the items chosen are not reflective of the investigated constructs. CH also scored higher than ICH in Music, an outcome that would appear to contradict Christman (2013), which specifically stated reggae and bluegrass as examples for musical genres with statistically significant differences between ICH and CH (using information from recording industry sales to qualify "popular" music versus "unpopular" music) and determined ICH had higher preference for these genres compared to CH (Christman, 2013). This study characterized "classical music" and "techno music" as the "unpopular" items in the Music category, in accordance with Nielsen's year-end report on music industry sales (Nielsen, 2015).

On that note, no similar sales data could be found to characterize items in the Food and Beverages questionnaire. As a result, that questionnaire may have limitations related to content validity. For that questionnaire, a better approach may have been to focus on well-known items with multiple customization options, e.g. pizza toppings, ice cream flavors, hamburger/sandwich ingredients, then to collect information on the popularity of those options and create an inventory centered on them. This would result in a Food questionnaire more similar in structure to the Media and Entertainment questionnaire.

Additionally, the study itself relies on self-report survey answers, which can present a problem with reliability as participants may interpret the rules and rating systems of the surveys, and in particular the nature of the items in the categories, differently. Thus, it is likely that a better way to explore the participants' responses would have been to use physical stimuli such as pictures of food, playlists of music, video game gameplay demos, and/or clips of television shows to prime real-time reactions rather than relying on participants' personal recollections. In such a design, one would have to consider the possibility that participants would evaluate the categories based on the examples chosen, rather than the subject matter of the genres as a whole. For example, to have a "platforming games" item in the Video games category, demonstrated with gameplay of *Super Mario Bros.* as opposed to a less-popular or lesser known platforming game, would have likely elicited its own subset of variations in response.

Ultimately, the experiment measured participants' "liking" of the survey items, which was not a sufficient proxy for measuring their "trying" of the survey items. This distinction would have been useful in eliciting observations of belief updating cognitions. In retrospect, it is unclear if there would have been differences between "liking" and "trying" items. Thus, a better approach would have been to frame the questionnaires in terms of willingness to consume certain foods or media, in hypothetical situations given no other options and/or offered for free, rather than an outright rating of like or dislike. This would coincide with methods of questioning that better rely on physical stimuli.

With these factors in mind, the premise of an existing effect of lateralization on personal preferences cannot be dismissed using this study. This study has only demonstrated that the present methods employed do not adequately produce evidence of the effect. It may be possible that a 1-to-5 Likert scale rating does not provide an adequate range to reach a conventional statistical significance, and therefore a 1-to-7 Likert scale, like Christman used (Christman, 2013), might have worked better. As for the questionnaires, they used sales data in forming their categories where possible, but issues of content validity remain, particularly in regards to the measurement of "liking" preferences versus "trying" preferences. An alternative would have been to employ a behavioral measure that more directly measures preferences. In summary, there were many ways this design could have been improved upon in the planning stages to more accurately collect data and represent the constructs it sought to measure.

Conclusion

Lateralization of function has been shown to influence differences in musical preferences (Christman, 2013). However, the present experiment could not produce statistically significant differences or empirical evidence of this relationship. The data from the current study did not reach the rigorous thresholds of scientific evidence and, when setting that fact aside, largely showed the opposite of this experiment's stated hypothesis. On top of this, there were many alternative design choices that could have been made, in retrospect, to better imitate Christman's work or otherwise demonstrate an association. While the data from this experiment is ultimately not as reliable as initially hoped, it is possible that the observations from this experiment can be put to better use in a revamped design for a future experiment to explore the effects of lateralization on personal preferences.

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Appendix A

Edinburgh Handedness Inventory

Please indicate your preference in the use of hands for each of the following activities/ objects by placing a check in the appropriate column.

	Always Left	Usually Left	No Preference	Usually Right	Always Right
Writing					
Drawing					
Spoon					
Open Jars					
Toothbrush					
Throwing					
Broom (upper hand)					
Scissors					
Knife					
Striking a match					

Is your mother left-handed? _____
Is your father left-handed? _____
How many brothers & sisters do you have? _____
Are any of your brothers and/or sisters left-handed? _____

Please write your age and circle your gender:
_____ years old M F

Appendix B

Survey: Food and Beverage Preferences

Please mark with a check in the column that best describes your attitude about the following consumables. If you've never eaten it or cannot due to cultural/dietary restrictions (i.e. not kosher, allergies), choose "No opinion/Not applicable."

	Strongly Dislike	Dislike	No opinion/Not applicable	Like	Strongly Like
Beans					
Bell peppers					
Cheese					
Cherries					
Coffee					
Cola					
Corn					
Cucumbers					
Eggplant					
Ham					
Ice Cream					
Ketchup					
Mayo					
Milk					
Mushrooms					
Mustard					
Pineapple					
Steak					
Strawberries					
Tea					
Tofu					
Tomatoes					
Tuna					
Turkey					
Yogurt					

Appendix C

Survey: Media and Entertainment Preferences

Please mark with a check in the most appropriate column your attitude about the following genres of entertainment. Indicate “No opinion” if you have no knowledge of the genre to render an opinion.

	Strongly Dislike	Dislike	No opinion	Like	Strongly Like
TV and movies					
Comedy					
Educational					
Mystery					
Political					
Talk/variety					
Drama					
Fantasy					
Horror					
Thriller					
Music					
Alternative rock					
Metal					
Rap					
Classical					
Rhythm and blues					
Techno					
Games					
Adventure games					
Fighting games					
Racing games					
Role-playing games					
Shooting games					